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FOR

**SYSTEMS AND METHODS FOR ACCESSING
INTERACTIVE CONTENT VIA SYNTHETIC CHANNELS**

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SYSTEMS AND METHODS FOR ACCESSING INTERACTIVE CONTENT VIA SYNTHETIC CHANNELS

TECHNICAL FIELD

5 This disclosure relates generally to electronic entertainment systems, and more particularly, but not exclusively, to systems and methods for accessing interactive content in an interactive television environment. Access to the interactive content is accomplished via synthetic channels that mimic traditional television broadcast “channels,” and that are communicated to a viewer via an electronic programming guide.

BACKGROUND

10 In recent years, the television has arguably become the predominant entertainment medium. With this proliferation has come a new form of communication/entertainment commonly referred to as “interactive television.” Interactive television generally comprises a video technology in which a viewer interacts with standard television programming. A typical
15 use of interactive television includes Internet access.

Whether a television signal received by a viewer’s television set takes the form of a standard broadcast, or is received via a cable connection, satellite dish, or otherwise, the typical viewer distinguishes between the variety of programming based on the concept of a “channel.” While the Federal Communications Commission-allocated broadcast channels remain effectively
20 unchanged, the growth of the cable industry and the digitalization of television provide an ever increasing number of “channels” from which to choose, and systems, utilizing such things as optical fibers or free-space optical transmission terminals, to deliver a multitude of “channels” simultaneously.

Interactive television and the interactive content it provides have traditionally
25 been accessed via an on-screen hierarchical menu display wherein the viewer might access or

“flip through” a number of displays to locate a desired interactive content item (*e.g.*, an Internet page). While this method of access has proven to be effective, it is also cumbersome when compared to the concept of a traditional cable channel, which the user might access via the actuation of a single button. Individuals unfamiliar with the technology, or the operation of such hierarchical menu displays may find this method of accessing interactive content difficult, frustrating, and invariably, time consuming.

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BRIEF DESCRIPTION OF THE
VARIOUS VIEWS OF THE DRAWINGS

The illustrated embodiments may be better understood by reference to the accompanying drawings. In the drawings, like reference numerals refer to like parts throughout the various views of the non-limiting and non-exhaustive embodiments of the present invention, and wherein:

Figure 1 is a pictorial block diagram illustrating an interactive television network environment in accordance with an embodiment of the invention;

Figure 2 is a schematic block diagram of a set-top-box in accordance with an embodiment of the invention;

Figure 3 is an illustration of an example electronic programming guide in accordance with an embodiment of the invention;

Figure 4 is a flow diagram illustrating an embodiment of a method of accessing interactive content in an interactive television viewing environment via synthetic channels; and

Figure 5 is a flow diagram illustrating an embodiment of a method of accessing a plurality of linked interactive content via an electronic programming guide in an interactive television viewing environment.

DETAILED DESCRIPTION OF
THE ILLUSTRATED EMBODIMENTS

The illustrated embodiments generally provide systems and methods for delivering interactive content to viewers via the utilization of synthetic channels mimicking traditional television broadcast or cable “channels.” Interactive television viewers may access and interact with the variety of interactive content provided by selecting a synthetic channel that will display, on the screen of the viewer’s television set or other display device, the start or home page of a particular user application, Internet web site, or other content or system page with which the user may interact, and which may be maintained on a local server, or other storage location. The synthetic channels may be administered by a cable provider, and communicated to the viewer via an electronic programming guide (“EPG”), which may also contain a traditional cable “channel lineup.”

Other features of the illustrated embodiments will be apparent to the reader from the foregoing and the appended claims, and as the ensuing detailed description and discussion is read in conjunction with the accompanying drawings.

In the following description, numerous specific details are provided to facilitate a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention can be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

Reference throughout the specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the

appearance of the phrases “in one embodiment” or “in an embodiment” in various places throughout the specification are not necessarily all referring to the same embodiment.

Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

5 Referring now to the drawings, and in particular to Figure 1, there is illustrated, generally at 10, an interactive television network environment in accordance with an embodiment of the invention. The interactive television network environment 10 provides access to both traditional cable channels, as well as synthetic channels, and includes, in one implementation, a television 12, a set-top-box (“STB”) 14, a remote control device 16, a headend 18, which may include a database 19, an Internet 20, and a public switched telephone network (“PSTN”) 22, or other network. The headend 18 may be connected to or comprise part of a cable television network (not shown).

10 In an alternate embodiment, the headend 18 may be replaced by a direct broadcast satellite (“DBS”) system operations center to facilitate the transmission of interactive television signals to a plurality of customers via a satellite transmission (herein, the term “broadcast center” is intended to refer to either a cable distribution headend, a DBS system operations center, or an equivalent). A DBS system may comprise a DBS system receiver dish comprising an 18-inch satellite dish (*i.e.*, the antenna for receiving a satellite broadcast signal), a digital integrated receiver/decoder (“IRD”) (the equivalent of the set-top-box 14; herein, the term “client terminal” is intended to refer to either a set-top-box, an IRD, or an equivalent) that separates each channel, and decompresses and translates the digital signal for display on a viewer’s television 12, and a remote control device 16.

Programming for the DBS system may be distributed, for example, by multiple high-power satellites in geosynchronous orbit, each with multiple transponders. Compression (*e.g.*, via a Moving Pictures Experts Group ("MPEG") standard, a set of standards for audio and video compression established by the Joint ISO/IEC Technical Committee on Information Technology) is used to increase the amount of programming that can be transmitted in the available bandwidth. In an embodiment, the IRD may communicate with the DBS system operations center via a back channel, which may comprise a telecommunications link via the PSTN 22, or via a network such as the Internet 20, or other suitable communication mechanism.

The DBS system operations center may be used to gather programming content, ensure its digital quality, and transmit the signal to the satellites. Programming may come to the DBS system operations center from content providers (*e.g.*, CNN®, ESPN®, TBS®, HBO®, and the like) via a satellite, fiber optic cable, and/or special digital tape in various embodiments. Satellite-delivered programming is typically immediately digitized, encrypted, and up-linked to the orbiting satellites. The satellites re-transmit the signal back down to each compatible DBS system receiver dish at customer's homes and businesses.

In various embodiments, some programming may be recorded on digital videotape in the DBS system operations center to be broadcast at a future time. Before any recorded programs are viewed by customers, technicians may utilize post-production equipment to view and analyze each tape to ensure audio and video quality. Tapes may then be loaded into robotic tape handling systems, and playback may be triggered by a computerized signal sent from a broadcast automation system. Back-up videotape playback equipment will ensure uninterrupted transmission at all times.

The reader will appreciate that the television 12, the STB 14, and the remote control device 16 comprise components of the interactive television network environment 10 maintained at the location of a viewer, for example, a home, an office, or any other location at which the content provided by the interactive television network environment 10 is desired. The headend 18 comprises a component of the network environment 10 maintained by a cable provider as part of a cable television network, which may comprise a plurality of headends, networks, satellite communication equipment, and the like. The Internet 20 and the PSTN 22 comprise components of the network environment 10 that can exist as entities distinct from the cable television network itself, but provide a foundation for communicating information to and from a variety of locales that may be as close as next door, or located throughout the world.

The television 12 may be configured to display television signals in a variety of formats, including analog signals, digital television formats, or high-definition television formats. The television 12 may utilize various technologies to display the television signals, such as standard cathode ray tube technology, liquid crystal display technology, liquid plasma display technology, or projection techniques. As illustrated in Figure 1, the television 12 may be coupled to the STB 14 in order to receive and display signals received from a cable television network via the headend 18. The reader will appreciate that although a television 12 is illustrated and described in conjunction with embodiments of the present invention, other video display devices known to those skilled in the art may also be utilized to display signals received from the cable television network or other network.

The STB 14 comprises a consumer electronics device that generally serves as a gateway between a customer's television and a broadband communication network, such as the cable television network. As its name implies, an STB 14 is typically located on top of, or in

close proximity to, a customer's television 12. In general, an embodiment of the STB 14 operates in conjunction with data streams encoded using a MPEG standard. STBs 14 are also capable of communicating via two-way data streams, allowing consumers to access electronic mail, web pages, video-on-demand, or other types of interactive content.

5 In one embodiment, the STB 14 receives encoded signals from the cable television network via the headend 18, and decodes the signal for display on the television 12. The STB may also receive commands from the viewer via the remote control device 16, or other suitable device, and transmit those commands back to the cable television network via the headend 18, or via an alternate communication route. For example, a viewer may utilize a
10 conventional keyboard (physically connected or remote), or may activate an on-screen keyboard to send e-mail, or for other text-based applications. In still other embodiments of the invention, the STB 14 may be connected to the Internet 20 or the PSTN 22 via connections separate from the connection to the headend 18, or may be connected to the headend 18 via a plurality of data communication channels.

15 In practice, a plurality of STBs may be connected to a centrally-located headend 18 that generally comprises a facility where cable television transmissions are received from a local cable television satellite downlink, or the like, and packaged together for transmission to customer homes. A number of headends 18 may be coupled together directly, or to one another through a network center, or via a separate network such as the Internet 20. In one embodiment,
20 a database 19 containing schedule information for television programming may be stored within one or more of the headends 18, the Internet 20, or a third party system coupled in one way or another to the headend 18. The database 19 may include, for example, program channels, dates, times, critical reviews, content ratings, VCRPlus® codes, and the like. In various embodiments,

copies of the database 19 can be periodically transmitted from the headend 18 to the STB 14 for local storage.

One mechanism for informing viewers (or potential viewers) of available programming accessible via the interactive television network environment 10 is through an

5 EPG. An EPG may provide an on-screen listing of all programming and content that interactive television subscribers have available to them at any given time.

In other embodiments, a remote control device 16, or other remote display device, such as a "web pad" or computer, may be utilized to display the EPG information. The remote display device may incorporate a touch sensitive display actuateable by a viewer with a finger or
10 other object, such as a stylus, to select "virtual" buttons or controls displayed on a screen of the remote device for channel selection, volume control, and the like. Displaying an EPG on a remote display device allows the television program currently displayed on the television to be viewed undisturbed, and provides an EPG display at a better resolution and size for viewing by the user. Embodiments of systems and methods for displaying EPG information on a remote
15 display are disclosed in greater detail in commonly-assigned U.S. Patent Application No. 09/811,373 , entitled INTERACTIVE, OFF-SCREEN ENTERTAINMENT GUIDE FOR PROGRAM SELECTION AND CONTROL, filed March 15 , 2001, and incorporated herein by reference.

Regardless of the manner or means by which the information of the EPG is
20 displayed, the EPG, in an embodiment of the present invention, displays information related to both traditional "broadcast" cable channels, as well as synthetic channels by which a user may access both television content and interactive content, respectively.

While traditional “broadcast” cable channels include television signals corresponding to conventional television programming, such as for example, NBC®, ESPN®, Nickelodeon®, TBS®, and the like, synthetic channels generally comprise functional channels, systems channels, and content channels corresponding to interactive programming content.

- 5 Functional channels provide access to computer-implemented applications that can be executed on behalf of the user, such as, for example, an event calendar, photo album, or e-mail service; system channels may comprise system pages that allow the user to administer a viewing environment via the STB 14; and content channels are informational in nature, providing such things as news, weather, and sports. The actual content of the content channels may be provided
- 10 by the cable provider, or by partners working in conjunction with the cable provider to produce particular content pages that are accessible via the content channels of the cable network’s EPG, for example. The content pages may comprise home pages or other pages corresponding to web sites available from the Internet 20, may comprise pages maintained and stored on a local server at, for example, the headend 18, or may comprise other browser-based or Internet Protocol
- 15 (“IP”)-based content available from a network location.

Having observed the general interaction of the various components of the interactive television network environment 10, attention may now be given to specific elements thereof, and the methods by which interactive content may be accessed via synthetic channels communicated to a viewer via an EPG. With reference now primarily to Figure 2, the STB 14

20 comprises a receiver 24, such as an infrared (“IR”) or radio frequency (“RF”) receiver. In other embodiments, the receiver 24 may be configured to receive other frequencies of the electromagnetic spectrum, such as UHF, VHF, microwave, or the like. The receiver 24 can receive control signals transmitted by the remote control device 16 (see, *e.g.*, Figure 1) for

operating the STB 14 and the television 12. The receiver may also receive other types of data, such as e-mail, and the like, for transmission to the headend 18 (see, *e.g.*, Figure 1).

In one implementation, the STB 14 also includes a transmitter 26, such as an IR or RF transmitter, configured, in one embodiment, to broadcast various types of information to the remote control device 16, such as television program schedule information, channel lineups, including traditional channels as well as synthetic channels, e-mail, and the like. As mentioned previously, the remote control device 16, or other similar device, may be configured to display textual or graphic information to the viewer. The remote control device 16 may also include a receiver and transmitter (not shown) similar to those components employed in the STB 14 to facilitate communication between the STB 14 and the remote control device 16.

The STB 14 also comprises a network interface 28 for providing access to the cable network via the headend 18. The network interface 28 may comprise a cable modem or the like, while in other embodiments, the functionality of the network interface 28 may be provided alternatively or in addition by a converter 30. In the illustrated embodiment, the converter 30 modulates and demodulates signals that are received or transmitted via the receiver 24 or the transmitter 26. A controller 32, for managing the operation of the STB 14, may be embodied as a microprocessor, digital signal processor, or other suitable device known in the art. The controller 32 may manage, for example, transmission and reception of signals to and from the headend 18, to and from the remote control device 16 (see, *e.g.*, Figure 1), or to and from a digital storage device 36 via a storage interface 34. The storage interface 34 is designed to retrieve and/or store information in the digital storage device 36, which may be a hard disk drive or other memory device.

As an overview, the reader will appreciate that the synthetic channels are provided in an EPG in a manner similar to that for conventional cable channels. Each channel number is associated with, and corresponds to, a particular television signal (in the case of a conventional cable channel), or to a user application, content page, or system administration page, as the case may be, for the functional channels, content channels, or system channels, respectively, which comprise the synthetic channels. Figure 3 is an illustration of an example EPG display 38 showing how the channel “line-up” and schedule information may be provided to a viewer for the available interactive programming content. Channels 1-949 (indicated by a channel field 40), for example, may comprise the conventional cable channels associated with television signals corresponding to NBC®, ESPN®, Nickelodeon®, TBS®, and the like, as mentioned previously, and may be followed by a current programming schedule (as indicated by a content field 42).

Channels 950-999, for example, may comprise the synthetic channels, and may, in an embodiment, be segregated into sections corresponding to functional channels, content channels, and/or system channels. For example, channels 950-959 may correspond to functional channels via which a user may activate an application such as an event calendar, a photo album, an e-mail service, or the like. Channels 960-969, for example, may correspond to content channels via which a user may access a content page comprised of an Internet page, or a page maintained on a local server in the headend, at some other location within the cable provider’s network, or elsewhere. Channels 970-989 may, in an embodiment, comprise content pages specifically designated by a user via a unique address in a manner that is similar to designating “favorites” in a standard browser application. This process will be described in greater detail hereinbelow in conjunction with Figure 4. Channels 990-999, for example, may correspond to

system channels wherein the user administers the STB environment. It is to be appreciated that these channel number designations are merely illustrative, and that various embodiments can designate channel numbers in any suitable manner.

A user may selectively view a traditional television program, or the interactive content programming simply by actuating a button, for example, on the remote control device 16, or a button located on the STB 14 itself, to select the desired channel. Channel selection may be done by actually pressing channel number buttons on the remote control device 16, or directly by using arrow keys or the like to scroll the channels shown on the EPG display 38 and then selecting "Enter." When an interactive content programming selection is activated, the previous television signal may, in an embodiment, continue to be displayed on the television screen as a background image. In other words, closing or exiting the interactive content programming selection will once again make entirely visible the television program that was previously being displayed on the television screen. Alternatively, or in addition, the television programming content may, when an interactive content programming selection is activated, be reduced in size and remain visible in, for example, a corner of the television screen or other display device.

With reference now primarily to an embodiment illustrated in Figure 4, a user, seeking to activate an interactive content programming selection, activates a "channel" button at block 44, which may be located, in an embodiment, on the remote control device 16 (see, *e.g.*, Figure 1). The remote control device 16 transmits a signal corresponding to the selected "channel" to the STB 14 at block 46. The transmitted signal may comprise an IR or RF signal as discussed previously in regard to the transmitter and receiver components of the STB 14 and remote control device 16. The STB 14, via the controller 32 (see, *e.g.*, Figure 2) and/or associated software, determines (at block 48) whether the selected "channel" falls within a first

predefined range, for example, 1-949 (corresponding, in the embodiment illustrated in Figure 3, to traditional television programming content), and if so, sends a signal to the television 12 to tune to the selected television signal at block 50. At this point, the process ends, awaiting selection of the next "channel." Tuning the television 12 to a traditional cable television signal is accomplished via conventional methods known to those skilled in the art. As such, a discussion of a process of tuning the television is beyond the scope of this invention, and will not be discussed in greater detail herein.

If the selected "channel" does not fall within the predefined range (see block 48 above), the STB 14 may, in an embodiment, next determine (at block 52) whether the selected "channel" falls within a second predefined range, for example, 950-999 (corresponding, in the embodiment illustrated in Figure 3, to interactive content programming). The reader will appreciate that an evaluation of the second predefined range will not always be necessary. For example, where the STB 14 only accepts a three-digit "channel" number, the determination (see, *e.g.*, block 48) as to whether the selected "channel" falls within the first predefined range may be sufficient to effectively determine whether the "channel" corresponds to traditional programming or interactive content programming.

Where additional "channels" are available or permitted beyond "999," and where the selected "channel" falls outside the second predefined range (see, *e.g.*, block 52), the STB 14 may indicate an "error" (see, *e.g.*, block 54), and the "channel" selection process may end, awaiting selection of the next "channel" by the user.

If the selected "channel" falls within the second predefined range corresponding to the interactive content programming in the illustrated embodiment, the STB 14, via the controller 32 and/or associated software, next correlates (see, *e.g.*, block 56) the selected

“channel” with an interactive content element, which may comprise a user application, or a content or system administration page. In an embodiment, each interactive content element corresponds to a defined synthetic channel number, for example, a user’s e-mail application may correspond to synthetic channel number 950, or a current sports content page may correspond to synthetic channel number 961 (see, *e.g.*, Figure 3).

After the selected “channel” has been correlated to the defined interactive content element, the STB 14 may send an uplink signal via an uplink path to the headend 18 requesting the interactive content element corresponding to the selected “channel” (see block 58). In other embodiments, the interactive content element corresponding to the selected “channel” may be broadcast from the headend 18 using a “carousel” technique, and be immediately available on the STB 14 (by, *e.g.*, caching the content on the STB) without the necessity of a headend request. In the carousel technique, the headend 18 may be configured to automatically send updated content information to the STBs 14. Using the carousel technique, the headend 18 sends a certain number of data packets in a particular sequence by, for example, out-of-band data transfer, IP multicast, or the like, and then repeats the sequence at regular intervals.

Communications between the STB 14 and the headend 18 may be encoded in a data over cable service interface specification (“DOCSIS”) protocol, an International Telecommunications Union standard that specifies functions, and internal and external interfaces for high-speed, bi-directional transfer of digital data between cable television networks and subscribers. Other suitable data communication protocols may also be utilized. In an embodiment, a browser (such as a web browser) located at the STB 14 may be launched and used to request the interactive content or interactive content element, such as by specifying the IP address or other address from where the interactive content may be retrieved.

When the signal requesting the interactive content element is received by the headend 18, the headend 18 retrieves the requested interactive content element from, for example, a memory storage device (see, *e.g.*, block 60), the Internet, or other network storage location, and transmits a downlink signal comprising the interactive content element to the STB 14 (see, *e.g.*, block 62). The cable provider may utilize a cable modem termination system at the headend 18 to route traffic coming in from a group of customers on a single channel to an Internet Service Provider ("ISP") for connection to the Internet 20. The cable provider may have servers and protocols for assigning and administering the IP addresses of the cable customer's, or may lease space to a third party ISP to carry out those functions.

The STB 14 may then receive the signal from the headend 18, comprising the interactive content element, via a downlink path, decode the signal via the network interface 28 (see, *e.g.*, Figure 2), and send the interactive content to the television 12 for display (see, *e.g.*, block 64), by a browser for example. When the interactive content element requested by the STB 14, and retrieved by the headend 18 comprises a user application, the particular application can be launched and executed from, for example, the database 19 or other server located at the headend 18, or the user application may be launched from the STB 14. In the case that the interactive content element corresponds to a content page, a browser application may be launched in a similar fashion from a headend server, or from the STB 14, and the particular home or start page corresponding to the selected synthetic channel can be retrieved from the Internet 20 or a database 19 via conventional methods, such as for example, transmission control protocol ("TCP"), IP, or hypertext transfer protocol ("HTTP"), or a protocol suite combining two or more of the foregoing, as will be familiar to those skilled in the art.

While an embodiment has been described above where the STB 14 retrieves the interactive content element by requesting it through the headend 18, it is to be appreciated that the interactive content element may be retrieved without necessarily having to go through the headend 18. For instance, the STB 14 can have an independent connection to the Internet 20, such that a browser in the STB 14 can directly retrieve interactive content element(s) available from the Internet 20. In yet other embodiments, the headend 18 can perform a type of “handoff” connection where it comprises part of the uplink connection to the Internet 20, but allows the downlink connection to occur directly between the Internet 20 and the STB 14.

As indicated above, a number of the synthetic channels may be reserved for the user to assign to a particular content page. To accomplish this, the user may, in an embodiment, access a synthetic system channel wherein a user may enter a desired content page address, for example, a universal resource locator (“URL”), or other identifier, such as an IP address. In any case, the identified address can be unique to the desired content page. Software associated with the system channel may link the designated address with the next available, or specified “channel” within the reserved range of synthetic channels available. In effect, this content specific user assignment of a synthetic channel reprograms the EPG that may be displayed for the particular user. This favorites information may then be updated at a user data storage device (e.g., database 19) maintained at the headend 18, which may then provide this programming information as part of the updated EPG transmitted to the particular customer. In this manner, a “mapping” of interactive content addresses to designated channel numbers can be provided.

With reference now primarily to an embodiment illustrated in Figure 5, a user, seeking to access a plurality of linked interactive content such as, for example, content pages comprising URL or other identifying address information to additional content pages, may

actuate a button or buttons on a remote control device to generate a first interactive command to activate an EPG (see, *e.g.*, block 66). The first interactive command may be received by the STB so that the EPG may be displayed on the video display device or television (see, *e.g.*, block 68), as indicated throughout the previous discussion. The EPG may include accessible broadcast

5 channels and accessible synthetic channels.

As indicated previously with reference to Figure 4, a user may select a synthetic “channel” from the EPG via actuation of a button or buttons to control a cursor or scroll through a list of available content in order to select a desired interactive content element (see, *e.g.*, block 70). Upon selecting the desired interactive content element, a second interactive command may

10 be received by the STB, the second interactive command comprising a synthetic channel selection. The STB may then correlate the selected “channel” with a first interactive content element (see, *e.g.*, block 72), and send a signal for the desired content to the headend, or other remote location, (see, *e.g.*, block 74) in a manner similar to that discussed above in conjunction with Figure 4.

15 The headend may then retrieve the requested content (see, *e.g.*, block 76), and transmit the content to the STB (see, *e.g.*, block 78) where the content is sent to the video display device to be displayed (see, *e.g.*, block 80) for viewing by the user. At this point, the user may desire to interact with the displayed content element, or access a second interactive content element which is linked to the first interactive content element via a URL or other address

20 identifier displayed in association with the first interactive content element (see, *e.g.* block 82). If the user wished to access a secondary interactive content element, the user may again actuate the remote control device to generate a third interactive command that may be received by the STB from which a signal may be sent to the headend or other location, requesting the second

interactive content element (in effect, blocks 74-82 are repeated until the user no longer desires to access additional linked interactive content elements). The headend may retrieve the second interactive content element, and send it to the STB for display in a manner similar to that discussed above. Following this same pattern, a user may actuate the remote control device to

5 generate a fourth interactive command requesting a third interactive content element, and so on, such that additional interactive commands may be utilized to access additional interactive content elements at the user's discretion.

While the invention is described and illustrated here in the context of a limited number of embodiments, the invention may be embodied in many forms without departing from the spirit of the essential characteristics of the invention. The illustrated and described embodiments, including what is described in the abstract of the disclosure, are therefore to be considered in all respects as illustrative and not restrictive. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.